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THE USE OF GASES ON SHIPS FOR FIRE EXTINCTION AND FUMIGATION.

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A review by L. E. Cofer, Assistant Surgeon General, United States Public Health Service.

The above paper was read by Mr. Scott on November 18, 1912, before the London Institute of Marine Engineers and appears in the transactions of the Institute of Marine Engineers of February, 1913. The paper is for all persons interested in the subject a most absorbing and useful one.

As far back as the fall of 1911 the Bureau of Public Health Service considered the question of the adaptability of fire-extinguishing devices on marine carriers for fumigation and disinfection purposes. So far an ideal combination for the purposes above mentioned has not been suggested, but it may be said that there is no better way of stimulating thought and investigation along these lines than by the preparation of such papers on this subject as the one read by Mr. Scott, and it is hoped that in the near future other investigations will be made into this important economic and public-health subject and that eventually an apparatus will be devised which every shipowner will be willing to install for the combined purpose of extinguishing fires in cargoes and of keeping vessels free from the carriers of quarantinable diseases.

Mr. Scott shows that fire is now one of the principal risks of sea transport, not only because it is an ever-present risk, but also because the interior fittings of passenger vessels have become more and more elaborate. He also claims that the possible damage due to fire increases with the size of the vessels, for the reason that the larger the holds the more nonconducting material there is between the seat of the fire and the cooled surfaces of the skin of the vessel or the deck above. It is shown that the problem of fire extinguishing on shipboard is somewhat similar to that with which fire brigades have to deal on shore, the ship being considered analogous to a theater

or hotel, where human life is principally involved, while a cargo boat is similar to the warehouse or store, where economic interests are at stake. The resemblance, it appears, ends there, because a ship's fire differs from a fire in a building in that it can be attacked only from above. Also it is in an inclosed space and partly below water level, and therefore water has to be carefully used. The principal difference lies in the fact that it is possible to make use of inert gases for fire extinction.

The methods of extinguishing fires on board ship are:

1. Closing the hatches.
2. Flooding the holds with water.
3. Blowing in steam.
4. Blowing in an inert gas, such as—
   (*a*) Carbon dioxide gas.
   (*b*) Sulphur dioxide gas.
   (*c*) Flue gas.

The fire-extinguishing agencies enumerated in division 4 are equally effective against animal life. Therefore it is in the use of inert gases, both for fire extinction and fumigation, that the next important step in ship sanitation will lie.

It is not the purpose here to discuss any other means for fumigating vessels than that known as the fumigation by the flue-gas method. The Bureau of Public Health Service has given this method a trial extending over about eight months, with the result that the method, so far as it goes, is very satisfactory. The experiments were conducted by Passed Assistant Surgeon Norman Roberts, of the Public Health Service, who was detached from the Hygienic Laboratory for the purpose. The flue gases were derived from an apparatus invented by Dr. George Harker, of Sydney, Australia. Dr. Roberts reports that from the standpoint of fumigation the system has many possibilities which so far have not even been thought of. Many cargoes—for example, tea and silk, foodstuffs, etc.—which would be damaged if exposed to sulphur gas in the presence of moisture, are not damaged when exposed to flue gas which has been washed and cooled. As a practical destroyer of rats in vessels, the flue gas is an absolute success. Investigations thus far carried out under the auspices of the Public Health Service have not proved, nor, for that matter, disproved, the practical value of the gas for purposes of insect destruction.

The active life-destroying constituent of the flue gas is carbon monoxide, which destroys rats and other red-blooded animals, but does not destroy insects. This is on account of its specific action on the hemoglobin which is present in the blood of vertebrates but absent in the blood of insects. According to Roberts, the inert gases, nitrogen and carbon dioxide, in flue gas do not directly cause

death, as they are not present in sufficient concentration to kill unaided; but the partial replacement of the oxygen in flue gas by carbonic-acid gas taxes the respiratory powers and reduces the concentration necessary to kill.

This partial dependence of the flue gas upon carbon dioxide for its poisonous qualities makes it considerably safer than a carbon monoxide-air mixture of equal toxicity, because, it is stated, if the flue gas be diluted with air both the carbon monoxide and the carbon dioxide will be weakened, whereas with the carbon monoxide-air mixture there is nothing to weaken except the carbon monoxide. This principle, it appears, when carried out to its logical conclusion, shows, first, that it is possible by reducing the carbon monoxide almost to the vanishing point and replacing the carbon dioxide until the mixture is irrespirable, to get a gas which can be safely used to destroy rats, even under circumstances whereby human beings might breathe a considerable quantity of the gas slightly diluted. It shows, further, that by entirely eliminating the carbon monoxide and proportioning the carbon dioxide and oxygen so as to be respirable yet fire extinctive, a gas would result with which inhabited compartments threatened by fire might be safely flooded. An example of such a gas is given as composed of: Nitrogen, 80 per cent; oxygen, 8 to 15 per cent; carbon dioxide, 5 to 12 per cent.

As stated above, insects are not affected by the flue gas unmixed, as insects have no hemoglobin. At times it has been noted that there is some constituent in the coal gas which kills insects. This is supposed to be sulphur. It has therefore been necessary, in order to kill insects with flue gas, to add some substance to the fuel. All of the substances thus far considered are gaseous or volatile liquids, such as sulphur dioxide, hydrocyanic gas, carbon disulphide, and carbon tetrachloride.

The necessity for adding to flue gas some substance producing a pungent or distinctly noticeable odor lies in the danger of asphyxiation of persons who enter the holds of vessels without first making careful tests as to the presence of carbon-monoxide gas. This is equivalent to saying that one of the disadvantages of flue gas is the fact that it is a constant source of danger to persons engaged in handling the gas for fumigation or fire-extinguishing purposes. It is therefore necessary to provide persons engaged in the fumigation of vessels with this gas with either a gas-rescue apparatus, or in addition to this, perhaps, one of the oxygen-resuscitation devices. One more advantage of the use of flue gas in the eradication of rats from vessels is the fact that if the fumigation is done on a large scale the cost of the output of the gas is relatively very low, as compared with the cost of the production of sulphur gas. The use of flue gas, however, is not profitable for the fumigation of small or separate com-

partments. Such compartments are best fumigated by means of small, independent gas generators of various kinds. It happens not infrequently in the fumigation of vessels that the use of sulphur gas is best adapted to some compartments, which are rendered air-tight with difficulty, while flue gas is best adapted to the holds of the vessels, provided, of course, they can be made air-tight.

The Public Health Service is now experimenting with the use of hydrocyanic-acid gas in the eradication of rats from loosely crated fruits and vegetables.

Dr. Roberts suggests that the flue gases adapted by the Harker system could be used in destroying rats in sewers. Here, however, account must be taken of the possibility of the gas finding its way in sufficient concentration into cellars and other places where human beings might be accidentally suffocated.

It may be stated that the use of flue gas for the fumigation of vessels for the destruction of animal life has a distinct place in maritime quarantine practice, and it only remains for the investigators to improve upon the methods of handling the gas, and also to devise a fuel the gases from which will kill insects. There is still another important consideration, and that is the part which marine architects may play in aiding sanitarians by eliminating in their plans of construction, as far as possible, all spaces and runways which would enable rodents and insects to escape the gaseous fumes which are intended for their destruction.

EPIDEMIC CEREBROSPINAL MENINGITIS.

INFORMATION RELATIVE TO THE PREVENTION OF ITS SPREAD AND THE MANAGEMENT OF CASES.

By R. H. VON EZDORF, Surgeon, United States Public Health Service.

On the appearance of epidemic cerebrospinal meningitis in a community the following measures will be found to be practicable of enforcement when modified to suit local conditions:

1. Prompt and early report of cases.

Local health authorities should adopt and enforce an ordinance requiring the immediate report of any case or suspected case of cerebrospinal meningitis by physicians, or heads of families, to the local health authorities.

A certificate, signed by such person, stating name of disease, the name, age, sex, and color of the patient suffering therefrom; and setting forth by street and number, or by other sufficient designation, the location of the house, room, or other place in which said patient can be found, should be required.

When said patient recovers or dies immediate notice should be sent to the local health authority.